COUNTY OF SAN DIEGO

GUIDELINES FOR DETERMINING SIGNIFICANCE

GEOLOGIC HAZARDS

LAND USE AND ENVIRONMENT GROUP

Department of Planning and Land Use
Department of Public Works

July 30, 2007

APPROVAL

I hereby certify that these **Guidelines for Determining Significance for Geologic Hazards** are a part of the County of San Diego, Land Use and Environment Group's Guidelines for Determining Significance and were considered by the Director of Planning and Land Use, in coordination with the Director of Public Works on the 30th day of July, 2007.

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Interim Director of Planning and Land Use

JOHN SNYDER
Director of Public Works

I hereby certify that these Guidelines for Determining Significance for Geologic Hazards are a part of the County of San Diego, Land Use and Environment Group's Guidelines for Determining Significance and have hereby been approved by the Deputy Chief Administrative Officer (DCAO) of the Land Use and Environment Group on the 30th day of July, 2007. The Director of Planning and Land Use is authorized to approve revisions to these Guidelines for Determining Significance for Geologic Hazards except any revisions to the Guidelines for Determining Significance presented in Section 4.0 must be approved by the DCAO.

Approved, July 30, 2007

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EXPLANATION

These Guidelines for Determining Significance for Geologic Hazards and information presented herein shall be used by County staff for the review of discretionary projects and environmental documents pursuant to the California Environmental Quality Act (CEQA). These Guidelines present a range of quantitative, qualitative, and performance levels for particular environmental effects. Normally (in the absence of substantial evidence to the contrary), non-compliance with a particular standard stated in these Guidelines will mean the project will result in a significant effect, whereas compliance will normally mean the effect will be determined to be “less than significant.” Section 15064(b) of the State CEQA Guidelines states:

> “The determination whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on factual and scientific data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting.”

The intent of these Guidelines is to provide a consistent, objective and predictable evaluation of significant effects. These Guidelines are not binding on any decision-maker and do not substitute for the use of independent judgment to determine significance or the evaluation of evidence in the record. The County reserves the right to modify these Guidelines in the event of scientific discovery or alterations in factual data that may alter the common application of a Guideline.

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List of Acronyms

AP	Alquist-Priolo
AP Zone	Alquist-Priolo Earthquake Fault Zone
CBC	California Building Code
CEQA	California Environmental Quality Act
CGS	California Geological Survey (formerly California Division of Mines and Geology)
CSR	Cyclic Stress Ratio
DMG	Division of Mines and Geology
FEMA	Federal Emergency Management Agency
FS	Factor of Safety
NEPA	National Environmental Policy Act
SEAOC	Structural Engineers Association of California
UBC	Uniform Building Code
USDA	United States Department of Agriculture
USGS	United States Geologic Survey

INTRODUCTION

This document provides guidance for evaluating adverse environmental effects that a proposed project may have from geological hazards. Specifically, this document addresses the following questions listed in the State CEQA Guidelines, Appendix G, Section VI., Geology and Soils:

Would the project:

a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:

    i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning map issued by the State Geologist for the area or based on other substantial evidence of a known fault?
    ii) Strong seismic ground shaking?
    iii) Seismic-related ground failure, including liquefaction?
    iv) Landslides?

c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction, or collapse?

d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?

1.0 GENERAL PRINCIPLES AND EXISTING CONDITIONS

Natural geologic processes that represent a hazard to life, health, or property are considered geologic hazards. Natural geologic hazards that affect people and property in San Diego County include earthquakes (which can cause surface fault rupture, ground shaking, and liquefaction), expansive soils, weathering, and mass wasting phenomena such as landslides and rockfalls. Although it is not possible to prevent or mitigate all geologic hazards, their destructive effects can be reduced to acceptable levels or avoided through appropriate site location and design.

1.1. Fault Rupture

During earthquakes the ground can rupture, either at or below the surface. Earthquakes can cause large vertical and/or horizontal displacement of the ground along the fault, and any structures built across a fault (or in very close proximity) may experience considerable damage or be completely destroyed in the event of surface fault rupture.

As shown on Figure 1, numerous faults have been mapped in San Diego County (Jennings, 1994 and Bryant, 2005). Each fault is classified based on its recency of movement as indicated below:

- Historic (movement within the last 200 years)
- Holocene (movement within the past 11,000 years)
- Late-Quaternary (movement within the past 700,000 years)
- Quaternary (age undifferentiated within the past 1.6 million years)
- Pre-Quaternary (movement older than 1.6 million years)

The source of mapping for some of the faults was of reconnaissance nature, and movement may have been more recent than indicated.

1.1.1 Alquist-Priolo Earthquake Fault Zones

The State of California has identified faults that represent a hazard of surface rupture as Alquist-Priolo Earthquake Fault Zones (AP Zones). While other active faults may exist, at least one fault within an AP Zone is known to have had active displacement within the Holocene (the last 11,000 years). Two main AP Zones extending from northwest to southeast across the northeast half of the County, the Elsinore and San Jacinto fault zones, present the highest threat of fault-rupture in the unincorporated portion of San Diego County (Figure 2).

1.1.2 County Special Study Zones

The Alquist-Priolo Act (AP Act) provides for a city or county to establish more restrictive policies than those within the AP Act, if desired. “Special Study Zones”, which are late-Quaternary faults mapped by the California Division of Mines and Geology (DMG), have been designated by the County. Late-Quaternary faults (movement during the past 700,000 years) were mapped based on geomorphic evidence similar to that of Holocene faults except that tectonic features are less distinct. As indicated by the DMG, these faults may be younger, but the lack of younger overlying deposits precludes more accurate age classification. Traces of faults within “Special Study Zones” are treated by the County as active unless a fault investigation can prove otherwise. Figure 2 depicts Special Study Zones within the unincorporated portion of the County.

1.1.3 Quaternary and Pre-Quaternary Faults

It should also be noted that other faults have been mapped as Quaternary (age undifferentiated within the past 1.6 million years) or Pre-Quaternary (older than 1.6 million years) by the DMG and shown on Figure 1 (Jennings, 1994 and Bryant, 2005). The source of mapping for some of the faults was of reconnaissance nature, and movement may have been more recent than indicated. Therefore, there is potential that not all of these faults are necessarily inactive.

1.2 Ground Shaking

Ground shaking is the earthquake effect that results in the vast majority of damage. Several factors control how ground motion interacts with structures, making the hazard of ground shaking difficult to predict. Seismic waves propagating through the earth's crust are responsible for the ground vibrations normally felt during an earthquake. Seismic waves can vibrate in any direction and at different frequencies, depending on the frequency content of the earthquake, its rupture mechanism, the distance from the earthquake source, or epicenter, to an affected site, and the path and material through which the waves are moving. All of San Diego County is located within Seismic Zone 4 (Sec. 1629.4.1 of the CBC), which is the highest Seismic Zone, and like most of Southern California, is subject to ground shaking.

In 1997, the UBC incorporated Near-Source Zones for calculating base shear, which accounts for high ground motion and damage that have been observed within a few kilometers of historic earthquake ruptures. These Near-Source Zones were developed by the Strong Ground Motion Ad-Hoc Subcommittee of the Seismology Committee of the Structural Engineers Association of California (SEAOC).

As shown on Figure 3, several Near-Source Zones occur in the County. Active faults (faults which are known to have been active during Holocene time within the past 11,000 years) in the unincorporated portion of the County were classified as A or B in accordance with the criteria specified in 1997 UBC Table 16-U (DMG, 1998).

Type A faults are capable of producing magnitude 7.0 earthquakes or greater and have a high rate of seismic activity (a slip rate of at least 5 millimeters per year). Segments of the San Jacinto and Elsinore fault zones are included in this category. Near-source velocity effects need to be considered in the design of buildings within 15 kilometers of a Type A fault.

Type B faults are the majority of the rest of the seismogenic faults in California, and segments of the San Jacinto, Elsinore, and Rose Canyon fault zones are included in this category. Near-source velocity effects need to be considered in the design of buildings within 10 kilometers of a Type B fault.

1.3 Liquefaction

Liquefaction occurs primarily in saturated, loose, fine to medium-grained soils in areas where the groundwater table is generally 50-feet or less below the surface. When these sediments are shaken during an earthquake, a sudden increase in pore water pressure causes the soils to lose strength and behave as a liquid. In general, three types of lateral ground displacement are generated from liquefaction: (1) flow failure, which generally occurs on steeper slopes, (2) lateral spread, which generally occurs on gentle slopes, and (3) ground oscillation, which occurs on relatively flat ground. In addition, surface improvements on liquefiable areas may be prone to settlement and related damage in the event of a large earthquake on a regionally active fault. The primary factors that control the type of failure that is induced by liquefaction (if any) include slope, and the density, continuity, and depth of the liquefiable layer.

1.3.1 Liquefaction History

Liquefaction is not known to have occurred historically in San Diego County, although liquefaction has occurred in the Imperial Valley in response to earthquakes with a magnitude of 6 or higher (URS, 2004). Historically, seismic shaking levels within the County have not been sufficient to trigger liquefaction.

1.3.2 Potential for Liquefaction

Within the County, there may be a potential for liquefaction in areas with loose sandy soils combined with a shallow groundwater table, which typically are located in alluvial river valleys/basins and floodplains. The extent of risk areas within the County with a potential for liquefaction hazard was mapped in the *Multi-Jurisdictional Hazard Mitigation Plan, San Diego, CA* (URS, 2004, Figure 4.3.6). The data used to profile the risk of liquefaction hazard included:

- Probabilistic peak ground acceleration (PGA) data from the United States Geologic Survey (USGS);
- Scenario Earthquake Shake Map for Rose Canyon from the California Integrated Seismic Network (CISN);
- Existing liquefaction areas from local maps; and
- National Earthquake Hazards Reduction Program (NEHRP) which rates soils from hard to soft (Type A through Type E), with the hardest soils being Type A, and the softest soils rated at Type E.

Figure 4 depicts areas with the potential for liquefaction in the County, which includes the data from above and also includes mapped Quaternary Alluvium and hydric soils (soils that are often saturated and/or characteristic of wetlands).

Table 1 is a list of hydric soils in San Diego County based on the USDA Soil Survey categories (Bowman 1973):

Table 1
Hydric Soils in San Diego County

Category	Soil Type and Slope
ChA	Chino fine sandy loam, 0 to 2 percent slopes
CkA	Chino silt loam, saline, 0 to 2 percent slopes
InA	Indio silt loam, 0 to 2 percent slopes
IoA	Indio silt loam, saline, 0 to 2 percent slopes
IsA	Indio silt loam, dark variant
Lu	Loamy alluvial land
MoA	Mecca sandy loam, saline, 0 to 2 percent slopes
MxA	Mottsville loamy coarse sand, wet, 0 to 2 percent slopes
Rm	Riverwash
Tf	Tidal flats
TuB	Tujunga sand, 0 to 5 percent slopes
VaA	Visalia sandy loam, 0 to 2 percent slopes

Primary areas for potential liquefaction hazard include the lower San Dieguito, Sweetwater, and San Luis Rey River Valleys, Jacumba, Borrego Valley near the Borrego Sink, and parts of Ramona.

1.4 Landslides

Landslides occur when masses of rock, earth, or debris move down a slope, including rock falls, deep failure of slopes, and shallow debris flows. Landslides are influenced by human activities such as grading and other construction activities, irrigation of slopes, mining activity, etc. and by natural factors such as precipitation, geology/soil types, surface/subsurface flow of water, and topography. Frequently, they may be triggered by other hazards such as floods and earthquakes. Landslides result from one or more distinct failure surfaces at rates that vary from a few centimeters per day to tens of meters of instantaneous movement. In contrast, creep is the imperceptibly slow, steady, downward movement of slope-forming soil or rock. Creep can occur seasonally, where movement is within the depth of soil affected by seasonal changes in soil moisture and soil temperature, or can be continuous or progressive. Rockfalls or topples are usually sudden and occur on steep slopes. In a rock fall, rocks may fall, bounce, or roll down the slope. A topple occurs when part of a steep slope breaks loose and rotates forward.

The most common cause of a landslide is down slope gravitational stress applied to slope materials (overly steep natural slopes, cliffs, man-made cuts and fills, etc.). Another common cause includes excessive rainfall or irrigation on a cliff or slope. A type of soil failure is slope wash, from the erosion of slopes by surface-water runoff. Earthquakes can trigger rockfalls, rock avalanches, debris flows, or other types of potentially damaging landslide movements. Seismic induced landslides can occur under a broad range of conditions that include: (1) steeply sloping to nearly flat land; (2) bedrock, unconsolidated sediments, or fill; and (3) dry to very wet conditions.

1.4.1 Landslide History

Previous landslides and landslide-prone sedimentary formations are located in western portions of the unincorporated County. However, landslides can also occur in the granitic terrain in the eastern portion of the County, although they are less prevalent (URS, 2004). The majority of significant landslides that have occurred are along coastal bluffs and other areas within incorporated portions of the County (URS, 2004). Reactivations of existing landslides can be triggered by situations such as heavy rainfall or irrigation, seismic shaking, and/or grading.

1.4.2 Potential for Landslides

The DMG has a series of 1:24,000 scale landslide hazard zone maps published for the western portion of the County largely within the incorporated portion of the County. Most of the unincorporated portion of the County has not been mapped by the DMG. The maps overlap the unincorporated portion of the County in areas such as Rancho Santa Fe, Otay Mesa, Jamul, Lakeside, and Valley Center. However, the entire County was screened to profile the risk of landslides in the *Multi-Jurisdictional Hazard Mitigation Plan, San Diego, CA* (URS, 2004, Figure 4.3.5). The data used to profile the risk of landslides included:

- Steep slopes (greater than 25%);
- Soil Series data (SANDAG based on USGS 1970s series);
- Soil-slip susceptibility from USGS; and
- DMG Landslide Hazard Zone Maps

Figure 5 depicts areas with the potential risk of landslides in the County that includes the data from above and also includes gabbroic soils on slopes steeper than 15% in grade, which is a slide prone material.

1.4.3 Rockfall

Areas with the highest potential for rockfall are primarily within the steeply sloped granitic regions of the County. Projects that include steep slopes greater than 25% in grade with rock outcrops are particularly susceptible to rockfall hazards. No attempt to map these areas has been made due to the sporadic nature of boulders and rocks in various terrains throughout the unincorporated portion of the County.

1.5 Expansive Soils

Certain types of clay soils expand when they are saturated and shrink when dried. These are called expansive soils, and can pose a threat to the integrity of improvements that are built on them without proper engineering, especially if the appropriate design measures are not incorporated and the human activities resulting from the project causes the moisture content of the soils to change. These soils are derived primarily from weathering of feldspar minerals and volcanic ash.

Areas with potential to have expansive soils within the County occur predominately in the coastal plains, an area of dissected marine terraces and uplands. They can also be found in valleys and on slopes in the foothills and mountains of the Peninsular Ranges Region and, to a lesser extent, in the desert (Figure 6).

The expansion and contraction of the soil varies with the soil moisture content (wet or dry), and can be aggravated by the way a property is maintained or irrigated. In the United States it has been estimated that expansive soils inflict more than twice the combined damage from earthquakes, floods, tornados, and hurricanes (ASCE, 1997). These soil movements and the damage they cause generally occur very slowly and the damage is spread over a wide area.

Table 2 is a list of clay soils in San Diego County based on the USDA Soil Survey categories (Bowman 1973):

Table 2
Clay Soils in San Diego County

Category	Soil Type
Altamont	AtC, AtD, AtD2, AtE, AtE2, AtF
Auld	AwC, AwD, AyE
Boomer	BoC, BoE, BrE, BrG
Bosanko	BsC, BsD, BsE, BtC
Diablo	DaC, DaD, DaE, DaE2, DaF
Diablo-Olivenhain	DoE
Huerhuero	HrC
Las Posas	LpB, LpC, Lc2, Ld2, Le2, LrE, LrE2, LrG
Linne	LsE, LsF
Olivenhain	OhC
Redding	RdC, ReE
Salinas	SbA, SbC, ScA, ScB
Stockpen	SuA, SuB

1.6 Tsunamis and Seiches

A tsunami is a series of large waves that are caused by a sudden disturbance that displaces water. Triggers for a tsunami include earthquakes, submarine landslides, volcanic eruptions, or meteor impacts. The County's coastline is largely within incorporated cities and on Camp Pendleton and tsunamis would not be expected to affect lands in the unincorporated County.

A seiche is a standing wave in a completely or partially enclosed body of water. Areas located along the shoreline of lakes or reservoirs are susceptible to inundation by a seiche. The size of a seiche and affected inundation area is dependant on different factors including size and depth of the water body, elevation, source, and if man made, the structural condition of the body of water in which the seiche occurs. Seiches are most likely to occur within fault rupture zones due to ground shaking, or by the sudden movement of a landslide into a reservoir. A seiche could result in localized flooding or damage to low lying areas adjacent to large bodies of water.

For more information and guidelines to determine the significance of tsunamis and seiches on a project, refer to the County of San Diego Guidelines for Determining Significance for Hydrology.

2.0 EXISTING REGULATIONS AND STANDARDS

There are several existing regulations that have been enacted to alleviate the harmful effects from geologic hazards. The following list details the most significant Federal, State and local regulations that apply to San Diego County.

2.1 Federal Regulations and Standards

National Environmental Policy Act (NEPA) [Pub. L. 91-190, 42 U.S.C. 4321-4347, January 1, 1970, as amended by Pub. L. 94-52, July 3, 1975, Pub. L. 94-83, August 9, 1975, and Pub. L. 97-258, § 4(b), Sept. 13, 1982 http://www4.law.cornell.edu/uscode/42/ch55.html]
The National Environmental Policy Act of 1969 requires that geologic hazards be considered when assessing the environmental impact of proposed federal projects.

USGS Landslide Hazard Program [http://landslides.usgs.gov/index.html]
The United States Geologic Survey (USGS) in fulfillment of the requirements of Public Law 106-113 created this program. The Federal Emergency Management Agency (FEMA) is the responsible agency for the long-term management of natural hazards. The Federal government takes the lead role in funding and conducting research, whereas the reduction of losses due to geologic hazards is primarily a State and local responsibility.

2.2 State Regulations and Standards

California Environmental Quality Act (CEQA) [Public Resources Code 21000-21178; California Code of Regulations, Guidelines for Implementation of CEQA, Appendix G, Title 14, Chapter 3, §15000-15387 http://ceres.ca.gov/topic/env_law/ceqa/]
Under CEQA, lead agencies are required to consider impacts from geologic hazards. The CEQA Guidelines are concerned with assessing impacts associated with geologic hazards that exist or may be created by project implementation.

Alquist-Priolo Earthquake Fault Zoning Act (AP Act) [Public Resources Code, Division 2, Chapter 7.5, § 2621-2630 http://www.consrv.ca.gov/CGS/rghm/ap/ and http://www.leginfo.ca.gov]
The California Legislature, as a result of the devastation caused by the 1971 Sylmar earthquake, passed the AP Act in 1972. This State law requires that proposed developments incorporating tracts of four or more dwelling units investigate the potential for ground rupture within AP Zones. These zones serve as an official notification of the probability of ground rupture during future earthquakes. Where such zones are designated, no building may be constructed on the line of the fault, and before any construction is allowed, a geologic study must be conducted to determine the locations of all active fault lines in the zone. The act also provides that a city or county may establish more restrictive policies, if desired (Spangle, et al., 1988).

The AP Zones that the State of California has designated along active faults in the unincorporated portion of the San Diego County are:

Elsinore Fault: North of Pala, Palomar Mountain, Pauma Valley, Lake Henshaw, Julian, Banner Canyon, Mason Valley, Vallecito Valley, and Carrizo Valley.

Earthquake Valley Fault: San Felipe Valley and Sentenac Canyon.

San Jacinto Zone - Coyote Creek Fault: Borrego Valley and Ocotillo Wells.

Policies and Criteria of the State Mining and Geology Board with reference to the Alquist-Priolo Earthquake Fault Zoning Act [California Code of Regulations (CCR) Title 14, Section 3600 et seq. http://www.consrv.ca.gov/cgs/codes/ccr/t14/3600.htm]
This subchapter sets forth the policies and criteria of the State Mining and Geology Board that govern the government's responsibilities to prohibit the locations of developments and structures for human occupancy across the trace of active faults within AP Zones.

Seismic Hazards Mapping Act [Public Resources Code, Division 2, Chapter 7.8, § 2690-2699.6 http://www.consrv.ca.gov/CGS/rghm/ap/ and http://www.leginfo.ca.gov]
This Act passed by the State in 1990 addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides. No seismic hazard maps have been completed by the State for the County of San Diego.

Uniform Building Code [1997 edition published by the Western Fire Chiefs Association and the International Conference of Building Officials, and the National Fire Protection Association Standards 13 &13-D, 1996 Edition, and 13-R, 1996 Edition]
The Uniform Building Code (UBC) is the primary means for authorizing and enforcing procedures and mechanisms to ensure safe building standards. The UBC uses a hazard classification system to determine what protective measures are required to protect human health and property. To ensure that these safety measures are met, the UBC employs a permit system based on hazard classification.

California Building Code [2001 edition, California Code of Regulations (CCR), Title 24, California Building Standards, Part 2]
The California Building Code (CBC), which was most recently adopted in 2001 (effective November 1, 2002) is based largely on the 1997 UBC, with the addition of more stringent seismic provisions for hospitals, schools, and essential facilities.

2.3 Local Regulations and Standards

San Diego County General Plan, Seismic Safety Element (Part V)
[http://ceres.ca.gov/planning/counties/San_Diego/plans.html]
The Seismic Safety Element of the General Plan provides background information, policies, and measures for protection of the public from unreasonable risks associated with the effects of seismically induced surface rupture, ground shaking, ground failure, tsunami, seiche, slope instability leading to landslides, subsidence and other geologic hazards. Maps of known seismic and other geological hazards are included.

San Diego County Zoning Ordinance Fault Displacement Area Regulations, [Section 5400-5406, http://www.co.san-diego.ca.us/cnty/cntydepts/landuse/planning/zoning/]
County Zoning Ordinance Sections 5400-5406 implement the requirements of the Alquist-Priolo Act. The provisions of sections 5400-5406 outline the allowable development, the permitting requirements, and the construction limitations within Fault Rupture Zones, as designated by the Alquist-Priolo Act.

The County prohibits the following uses within AP Zones (Section 5404, Zoning Ordinance):

- Uses containing structures with a capacity of 300 people or more. Any use having the capacity to serve, house, entertain, or otherwise accommodate 300 or more persons at any one time.
- Uses with the potential to severely damage the environment or cause major loss of life. Any use having the potential to severely damage the environment or cause major loss of life if destroyed, such as dams, reservoirs, petroleum storage facilities, and electrical power plants powered by nuclear reactors.
- Specific civic uses. Police and fire stations, schools, hospitals, rest homes, nursing homes, and emergency communication facilities.

The County prohibits any buildings or structures to be used for human occupancy to be constructed over or within 50 feet of the trace of known fault (Section 5406, Zoning Ordinance). The County generally requires geologic reports for development proposed in AP Zones (Sec. 5406 b., Zoning Ordinance).

For a non-discretionary permit such as a building permit, the Department of Planning and Land Use, Building Division requires any above-surface structure to conform to the seismic requirements of the CBC and to incorporate the design recommendations contained within the soils and geologic report as required per the Code.

San Diego County Grading Ordinance, Chapter 4 – Design Standards and Performance Requirements [http://www.sdcounty.ca.gov/dpw/docs/propgradord.pdf]
Chapter 4 of the County Grading Ordinance (which commences at Section 87.101 of the County Code) includes requirements for the maximum slope allowed for cut and fill slopes, the requirement for drainage terraces on cut or fill slopes exceeding 40 feet in height, expansive soil requirements for cuts and fills, minimum setback requirements for buildings from cut or fill slopes, and reporting requirements including a soil engineer's report and a final engineering geology report by an engineering geologist, which includes specific approval of the grading as affected by geological factors.

3.0 TYPICAL ADVERSE EFFECTS

Geologic hazards have clearly definable physical effects. Earthquakes are a primary cause of geologic hazards in San Diego County and can impact extensive regions of land. Earthquakes can produce fault rupture and strong ground shaking, and can trigger landslides, rockfalls, soil liquefaction, tsunamis, and seiches. Overly steep slopes and/or water-saturated slopes are also common causes of landslides. In turn, these geologic hazards can lead to other hazards such as fires, dam failures, and toxic chemical releases.

Primary effects of earthquakes include violent ground motion, and sometimes permanent displacement of land associated with surface rupture. Earthquakes can snap and uproot trees, or knock people to the ground. They can also shear or collapse large buildings, bridges, dams, tunnels, pipelines and other rigid structures, as well as damage transportation systems, such as highways, railroads and airports.

Secondary effects of earthquakes include near-term phenomena such as liquefaction, landslides, fires, tsunamis, seiches and floods. Long-term effects associated with earthquakes include phenomena such as regional subsidence or emergence of landmasses and regional changes in groundwater levels.

While not as dramatic and life-threatening as earthquakes or landslides, expansive soils pose a threat to the structural integrity of buildings and other infrastructure, and in the United States expansive soils have caused more financial damage overall than any other geologic hazard.

3.1 Fault Rupture

Known active faults that represent a hazard of surface rupture have been identified by the State of California as AP Zones. As new geologic information becomes available the County may also zone other faults as “active,” if necessary. Ground rupture can completely demolish structures by rupturing foundations or by tilting foundation slabs and walls, as well as damage buried and above ground utilities. Drinking water can be lost, and the loss of water lines or water pressure can affect emergency services, including fire fighting ability.

3.2 Ground Shaking

Ground shaking is the most common effect of earthquakes that adversely affects people, animals, and constructed improvements. People and animals can be knocked down and injured during ground shaking or killed by falling or sliding furniture and debris. Ground shaking can knock unanchored single family residences and mobile homes off their foundations. Chimneys with no reinforcing steel or those that are not secured to the main structure can topple or collapse. Ground shaking can cause landslides and rockfalls that can damage structures and infrastructure, and injure or kill people and animals.

The USGS (Marshall and Stein, 1994) identified the principal effects of the ground shaking in the 1994 Northridge earthquake as:

- Buildings damaged to the point where occupants were barred from entry;
- Bridge damage (minor to major) and collapsed bridges;
- Landslides;
- Ground cracking and surface faulting; and
- Liquefaction.

Any of these adverse effects could occur in San Diego County during ground shaking.

Another example would be the 1971 earthquake on the edge of the San Fernando Valley, where lower Van Norman Dam above the San Fernando Valley was severely damaged and on brink of catastrophic failure, threatening the lives of 80,000 people who evacuated their homes below the dam. Dams in San Diego County could be damaged or collapsed from ground shaking during a similar, large earthquake.

3.3 Liquefaction

Liquefaction occurs when saturated, unconsolidated sediments are violently shaken during an earthquake. This can cause a sudden increase in pore water pressure which in turn causes the soils to lose strength and behave as a liquid. Adverse effects of liquefaction include:

- Loss of bearing strength so that the ground loses its ability to support structures. Structures can be left leaning or they can collapse.
- Lateral spreading where the ground can slide on a buried liquefied layer. Buildings, roads, pipelines and other structures can be damaged.
- Sand boils of sand-laden water can be ejected from a buried liquefied layer and erupt at the surface. The surrounding ground often fractures and settles.
- Ground oscillation so that the surface layer, riding on a buried liquefied layer, is thrown back and forth by the shaking and can be severely deformed. The land, walkways, roads, highways, structures can all be shaken, broken, damaged and/or destroyed.
- Flotation to the surface of light-weight structures that are buried in the ground (e.g. pipelines, sewers, and nearly empty fuel tanks).
- Settlement when liquefied ground re-consolidates following an earthquake.

3.4 Landslides

Human use of slopes has led to both an increase in some landslide events, such as landslides on hillside development where slopes have been overly steepened or ancient landslides reactivated by increased loading, removal of buttressing material or saturation of a weak seam caused by changes in groundwater movement.

An example of a typical adverse effect of landslides is the loss of man-made structures, utilities and roads and/or loss of life by a landslide or rockfall that originated on an unstable area upslope of a home. Adverse effects vary with the size or volume of individual landslides/rockfall events and density of development below. The magnitude of such events can range from movement as small as a single boulder to massive movement of millions of cubic yards of material.

3.5 Expansive Soils

Construction of homes or other improvements on expansive soils can pose a threat to the integrity of structures that are built on them without proper engineering. These soil movements, and the damage they cause, generally occur very slowly and the damage can be spread over a wide area.

Expansive clay soils are known to cause adverse effects on a wide variety of structures and surface improvements. Expansive soil expands and contracts due to changes in the moisture content of the soil, causing structural problems through differential movement of the structure. If the moisture content and or soil type differs at various locations under the foundation, localized or non-uniform movement may occur in the structure. This movement can cause damage to the foundation and building structural system, evidenced by cracking of the slab or foundation, cracking in the exterior or interior wall coverings (indicating movement of support framing,) uneven floors and/or misaligned doors and windows. This type of movement is usually associated with slabs on-grade, but also occurs in structures with basements and crawlspaces.

A second effect of expansive soils is additional horizontal pressure applied to foundation walls found in basements and crawlspaces. Increased moisture in the soils adjacent to the foundation wall will cause the soils to expand, which will increase the lateral pressure applied to the foundation wall. If the foundation wall does not have sufficient strength, damage ranging from minor cracking, bowing (or other movement), to serious structural damage or failure of the wall may occur.

A third effect associated with clay soil is the movement of soils on slopes. Expansive clay soil, found as a layer under a more rigid top layer of soils, can become unstable as the moisture content increases, allowing the claystone and the top layers of soils to move. If the soil is located on a slope, the top layer of soil can creep (slow movement) down hill or even result in a landslide (sudden and dramatic movement along a distinct failure surface). Consequently, a residence or other structure with an inadequate foundation built on a slope subject to creeping may be damaged or destroyed depending on the severity of the slope. Adverse effects from creep also include curved tree trunks, bent fences or retaining walls, tilted poles or fences, and small soil ripples or ridges.

4.0 GUIDELINES FOR DETERMINING SIGNIFICANCE

This section provides guidance for evaluating adverse environmental effects from geologic hazards on a project. These Guidelines are organized into five subject areas based on the State CEQA Guidelines, Appendix G, Section VI, which addresses geologic hazards. The primary goal of these guidelines is to establish measurable standards for determining when an impact will be considered significant pursuant to CEQA.

The following significance guidelines should guide the evaluation of whether a significant impact from geologic hazards will occur as a result of project implementation. A project will generally be considered to have a significant effect if it proposes any of the following, absent specific evidence to the contrary. Conversely, if a project does not propose any of the following, it will generally not be considered to have a significant effect from geologic hazards, absent specific evidence of such an effect:

4.1 <u>Fault Rupture</u>

a. ***The project proposes any building or structure to be used for human occupancy over or within 50 feet of the trace of an Alquist-Priolo fault or County Special Study Zone fault.***

b. ***The project proposes the following uses within an AP Zone which are prohibited by the County:***

i. ***Uses containing structures with a capacity of 300 people or more.*** *Any use having the capacity to serve, house, entertain, or otherwise accommodate 300 or more persons at any one time.*

ii. ***Uses with the potential to severely damage the environment or cause major loss of life.*** *Any use having the potential to severely damage the environment or cause major loss of life if destroyed, such as dams, reservoirs, petroleum storage facilities, and electrical power plants powered by nuclear reactors.*

iii. ***Specific civic uses.*** *Police and fire stations, schools, hospitals, rest homes, nursing homes, and emergency communication facilities.*

Significance Guidelines 4.1.a and 4.1.b address question a) i) of Section VI of Appendix G of the State CEQA Guidelines. Specific criteria of the State Mining and Geology Board in reference to the AP Act states that unless a geologic investigation can prove otherwise, the area within 50 feet of the trace of an AP fault shall be presumed to be underlain by active branches of that fault and no structures shall be permitted in this area. In accordance with the County Zoning Ordinance, these guidelines further restrict development for human habitation to have at least a 50 foot setback from the trace of an AP fault. Exemptions to these guidelines are noted within Section 5406 of the County Zoning Ordinance as follows:

1. Buildings and structures not intended or used for human occupancy.
2. Alterations or repairs to an existing structure provided that the aggregate value of the work performed does not exceed 50-percent of the value of the existing structure and does not adversely affect the structural integrity of the existing structure.
3. A single-family wood frame dwelling not exceeding 2-stories in height which is built or located as part of a development of less than four (4) such dwellings. (***<u>Important Note:</u>*** *This exemption is based on an exemption allowed within the AP Act. It should be clear while this exemption exists, the County <u>will not</u> allow any new single-family wood frame dwellings to be placed over the trace of an active fault.)*
4. A mobile home whose body width exceeds 8-feet.
5. Swimming pools, decorative walls, fences, and minor work of a similar nature.

Significance Guideline 4.1.b is in accordance with Fault Displacement Area regulations within the County Zoning Ordinance. Each of the above significance guidelines is stricter than the guidelines within the AP Act. Section 2624 of the Alquist-Priolo Earthquake Fault Zoning Act (AP Act) (Public Resources Code Division 2, Chapter 7.5, Section 2624) provides authority to counties to adopt policies stricter than those established by the AP Act or the State Mining and Geology Board. The County adopted these as conservative measures to further protect human life, structures, and the environment.

4.2 Ground Shaking

The project site is located within a County Near-Source Shaking Zone or within Seismic Zone 4 and the project does not conform to the Uniform Building Code (UBC).

Significance Guideline 4.2 addresses question a) ii) of Section VI of Appendix G of the State CEQA Guidelines and relies upon conformance to the UBC Seismic Hazards Standards for construction within areas prone to ground shaking. The entire County is within Seismic Zone 4 and is subject to seismic ground shaking. Near-Source Shaking Zones have been defined predominately along the Elsinore and San Jacinto fault zones in the eastern portions of the unincorporated portion of the County. Inevitably, all construction projects in the County may be affected by seismic shaking; therefore, construction design standards have been developed to ensure structures perform in a predictable manner during seismic events. The last few decades have produced significant strides in structural design methodologies that have been incorporated into local building codes, lowering risks associated with large seismic events.

4.3 Liquefaction

The project site has potential to expose people or structures to substantial adverse effects because:

- ***i. The project site has potentially liquefiable soils; and***
- ***ii. The potentially liquefiable soils are saturated or have the potential to become saturated; and***
- ***iii. In-situ soil densities are not sufficiently high to preclude liquefaction.***

Significance Guideline 4.3 addresses question a) iii) of Section VI of Appendix G of the State CEQA Guidelines and the portion of question c) that addresses on-site and off-site lateral spreading or liquefaction. There are a number of factors necessary to determine if there is a potential liquefaction hazard at a project site. An affirmative response to <u>all</u> of the criteria in the guidelines would be considered a significant impact. This significance guideline relies on guidance provided by the State Department of Mines and Geology Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards in California.* This document provides detailed information regarding assessment of potential liquefaction hazards as well as mitigation measures which can be employed to reduce hazards to levels that would be considered less than significant.

4.4 Landslides

a. The project site would expose people or structures to substantial adverse effects, including the risk of loss, injury, or death involving landslides.

b. The project is located on a geologic unit or soil that is unstable, or would become unstable as a result of the project, potentially resulting in an on- or off-site landslide.

c. The project site lies directly below or on a known area subject to rockfall which could result in collapse of structures.

Significance Guidelines 4.4.a through 4.4.c address question a) iv) of Section VI of Appendix G of the State CEQA Guidelines and the portion of question c) that relates to on- or off-site landslide or collapse. If any Guideline listed under 4.4 has an affirmative response, the impact would be significant. If a project site is located on or within 500 feet of a "Landslide Susceptibility Area" as depicted on Figure 5, a Geologic Reconnaissance Report may be required to evaluate the risk of landslides or rockfall and to determine if the project may have a significant impact. Up to a 1,000 foot buffer area around project sites may be required to be evaluated to determine if potential off-site hazards are present which could affect the project.

A Geologic Reconnaissance Report will evaluate whether there are any risks to people or property from landslides or rockfall. If the Geologic Reconnaissance Report indicates a potentially significant impact from potential landslides or rockfall, feasible mitigation or design measures (as discussed in Section 5) should be included that would reduce potentially significant impacts to levels below significance. A Geologic Investigation may be required to provide a more comprehensive evaluation for the potential of landslides or rockfall and to provide engineering design measures to mitigate impacts.

4.5 Expansive soils

The project is located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), and does not conform with the Uniform Building Code.

Significance Guideline 4.5 addresses question d) of Section VI of Appendix G of the State CEQA Guidelines. Soils are expansive if the amount of clay and predominant clay mineral is greater than 30% mixed or montmorillonitic clays (United States Department of Agriculture, Part III, San Diego Soil Survey, 1973).

This significance guideline relies upon conformance to the Uniform Building Code's Expansive Soil Standards for construction on soils that are within a high shrink/swell category as defined by the U.S. Department of Agriculture (USDA), San Diego Soil Survey. Expansive soils are present throughout San Diego County. Inevitably most construction projects in San Diego County may be affected by expansive soils; therefore, construction standards have been developed to ensure structures can withstand changes in the integrity of the soil. Structural engineering standards have been incorporated into the UBC, lowering associated risks.

5.0 STANDARD MITIGATION AND PROJECT DESIGN CONSIDERATIONS

A project will be evaluated for its effect on geologic hazards under the criteria specified in Section 4.0. If mitigation or project design considerations are identified that could reduce a significant effect, those shall be incorporated into the project. While project design elements and/or mitigation shall be incorporated into a project, it may not always be possible to reduce the impact to less than significant. In general, if mitigation or project redesign does not reduce a significant impact to geologic hazards to less than significant, the impact will be considered significant and unmitigable.

Any above ground structure is required to comply with the structural parameters set forth within the most current edition of the UBC. If the area is located within a zone that will be affected by ground shaking from a seismic event or is located within an area that has high shrink-swell soils, compliance with the structural and engineering standards set forth within the UBC will be required as project design considerations. Building to the UBC guidelines will mitigate most impacts to less than significant. The following are additional mitigation measures as outlined by the California Department of Conservation, Geological Survey, Special Publication 117, 1997.

5.1 Fault Rupture Hazard

The hazard assessment required for project sites within zones of required investigation should successfully determine (a) the location or absence of hazardous faults on or adjacent to the site; and the ages of past rupture events, (b) the distribution of primary and secondary faulting, (c) the probability of, or relative potential for future surface displacement, and (d) the degree of confidence in and limitations of these conclusions.

Avoidance is the primary goal for hazards relating to fault rupture zones. The County requires that no structure for human occupancy shall be permitted to be placed across the trace of an active fault and that there is at least a 50-foot setback from the trace of an active fault for such structures. If the trace of the fault is inferred through portions of the project site, the setback distance will depend on the quality of data and type and complexity of fault(s) encountered at the site. The setbacks required on areas of indirect interpretive methods will be more restrictive than the above-discussed 50-foot setback.

5.2 Ground Shaking Hazard

Hazards associated with ground shaking are mitigated through following the UBC Seismic Hazards Standards for construction within a County Near-Source Seismic Shaking Zone or Seismic Zone 4. Inevitably most construction projects in the County may be affected by seismic shaking; therefore, construction standards have been developed to ensure structures can withstand seismic events. The last decade has produced significant strides in structural engineering that have been incorporated into the UBC, lowering associated risks. Effective design measures include constructing earth fills to partially absorb underlying ground movements; isolating foundations from the underlying ground movements; and designing strong, ductile foundations that can accommodate some deformation without compromising the functionality of the structure. (Bray and Kelson, 2006).

5.3 Liquefaction Hazard

The hazard assessment required for project sites within areas of required investigation should (a) demonstrate that liquefaction at a proposed project site poses a sufficiently low hazard as to satisfy the defined acceptable level of risk criteria, or (b) result in implementation of suitable mitigation recommendations to effectively reduce the hazard to acceptable levels. Mitigation should provide a suitable level of protection with regard to potential lateral spread failures, and more localized problems including bearing failure, settlements, and lateral displacement. The scope and type(s) of mitigation required depend on the site conditions present and the nature of the proposed project.

5.4 Landslide Hazard

For any existing or proposed slopes that are determined to be unstable, appropriate mitigation measures will be provided before the project is approved. The hazards these slopes present can be mitigated in one of three ways:

5.4.1 Avoid the Hazard

Where the potential for failure is beyond the acceptable level and not preventable by practical means, the hazard should be avoided. Developments should be built sufficiently far away from the threat so they will not be affected if the slope fails.

5.4.2 Protect the Site from the Hazard

While it is not always possible to prevent slope failures occurring above a project site, it is sometimes possible to protect the site from the runout of failed slope materials. This is particularly true for sites located at or near the base of steep slopes, which can receive large amounts of material from shallow disaggregated landslides or debris flows. These methods include catchments and/or protective structures such as basins, embankments, diversion or barrier walls, and fences.

5.4.3 Reduce the Hazard to an Acceptable Level

Unstable slopes affecting a project can be rendered stable (that is, by increasing the factor of safety to >1.5 for static and 1.1 for dynamic loads) by eliminating or reducing the slope, removing the unstable soil and rock materials, or applying one or more appropriate slope stabilization methods (such as buttress fills, sub drains, soil nailing, crib walls, etc.) For deep-seated slope instability, strengthening the design of the structure (e.g., reinforced foundations) is generally not by itself an adequate mitigation measure.

Lastly, project sites that are outside of a zone of required investigation may be affected by ground-failure run out from adjacent or nearby slopes. Any proposed mitigation should address all recognized significant off-site hazards.

6.0 REPORTING REQUIREMENTS

The general outlines for the typical types of reports that may be required in lands designated within Geologic Hazard Zones or Areas are included in Attachment A. A California Certified Engineering Geologist shall complete the report. As discussed in Attachment A, projects may require a Geologic Reconnaissance Report or a more detailed Geologic Investigation depending on the type of potential geologic hazard(s) present on a particular project site.

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Figure 1 – Mapped Faults in San Diego County

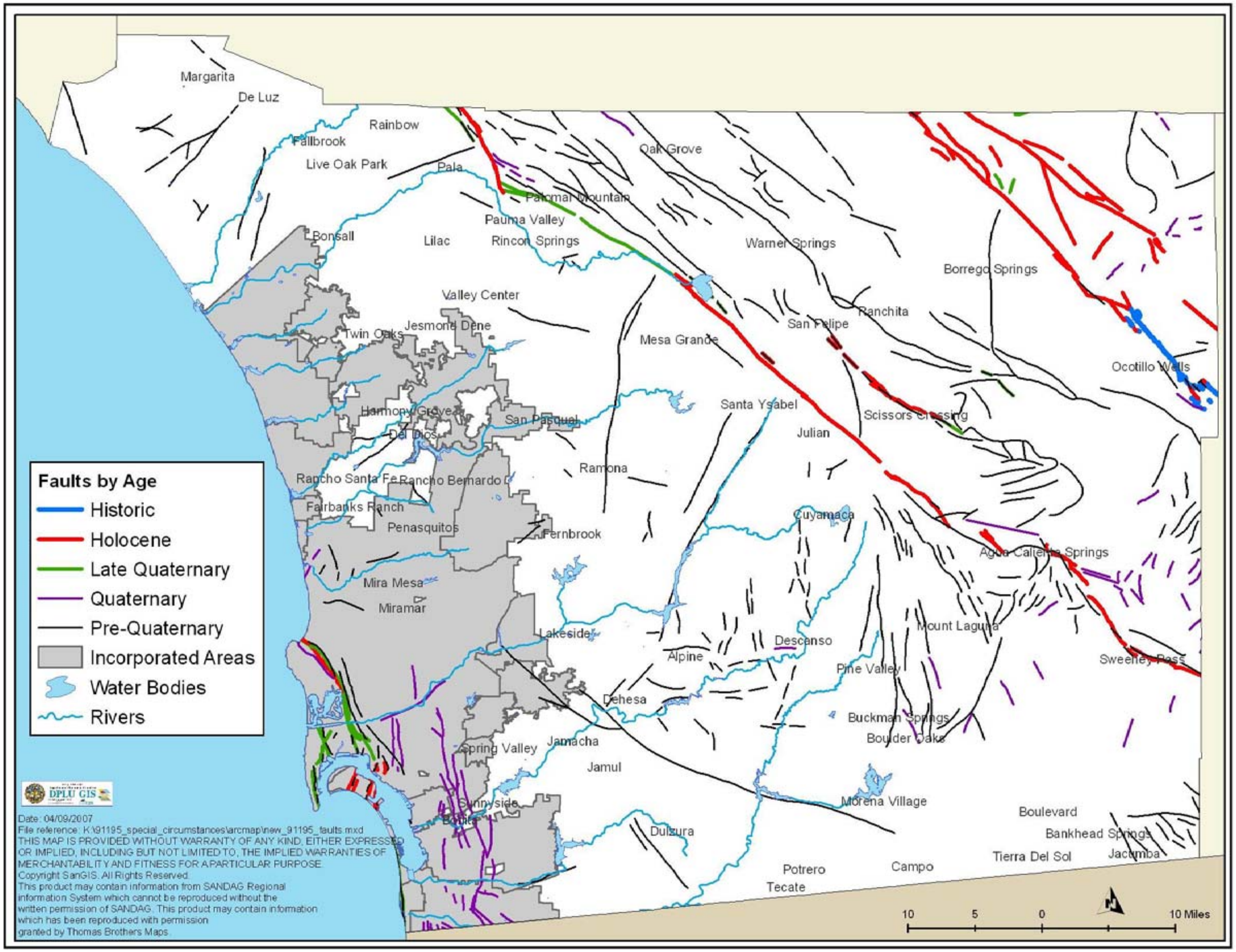


Figure 2 – Alquist-Priolo and County Special Study Fault Zones

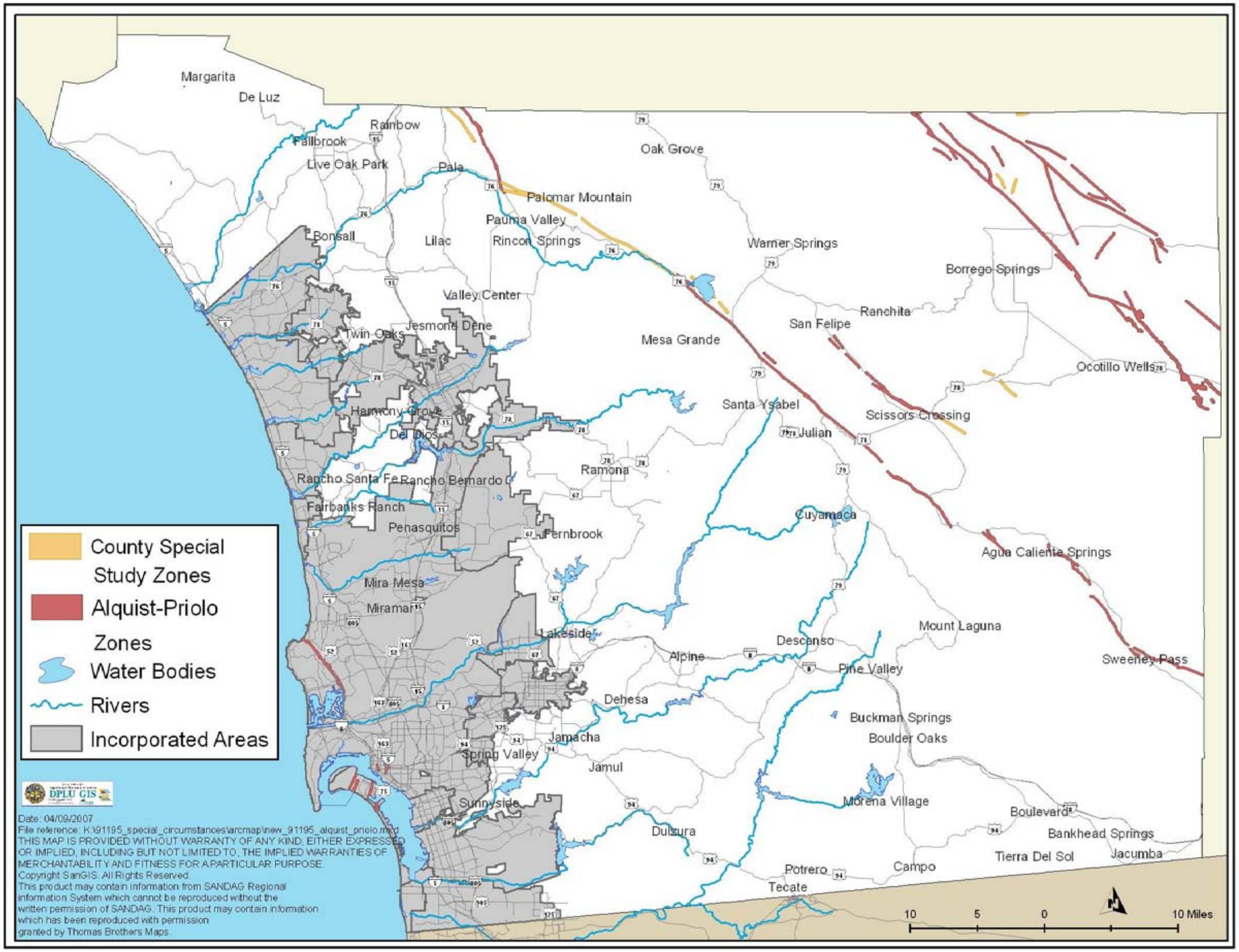


Figure 3 – Near-Source Shaking Zones

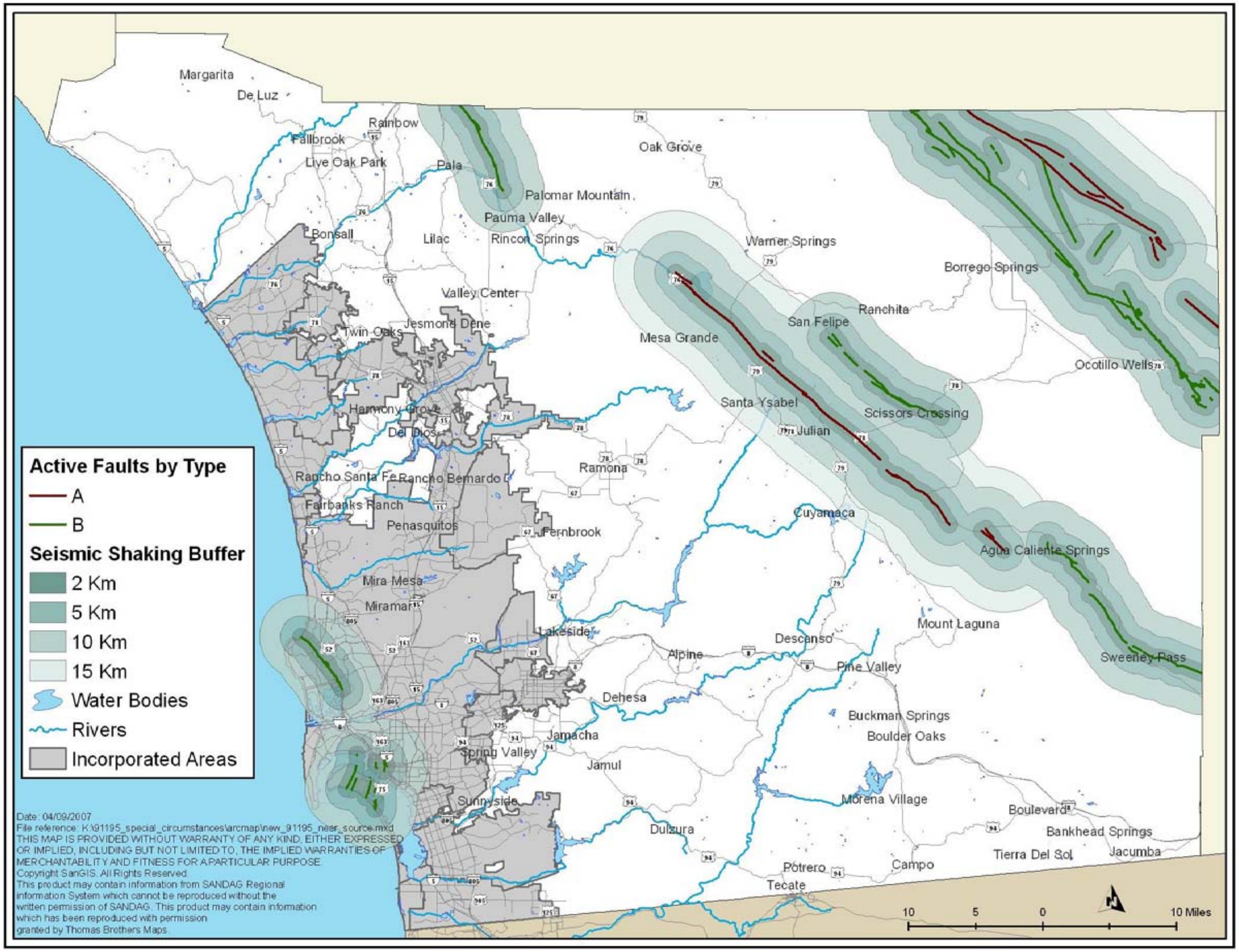


Figure 4 – Potential Liquefaction Areas

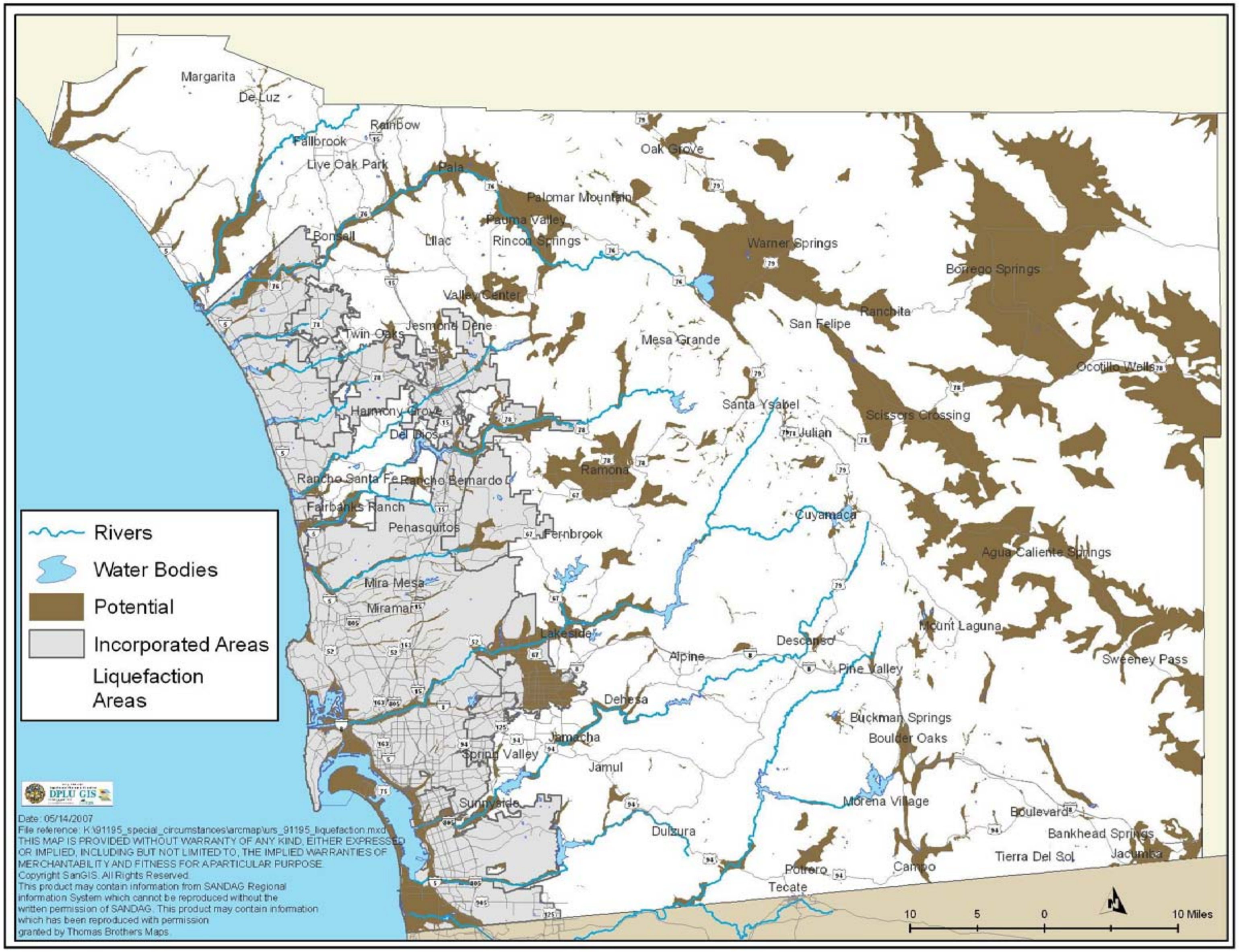


Figure 5 – County Landslide Susceptibility Areas

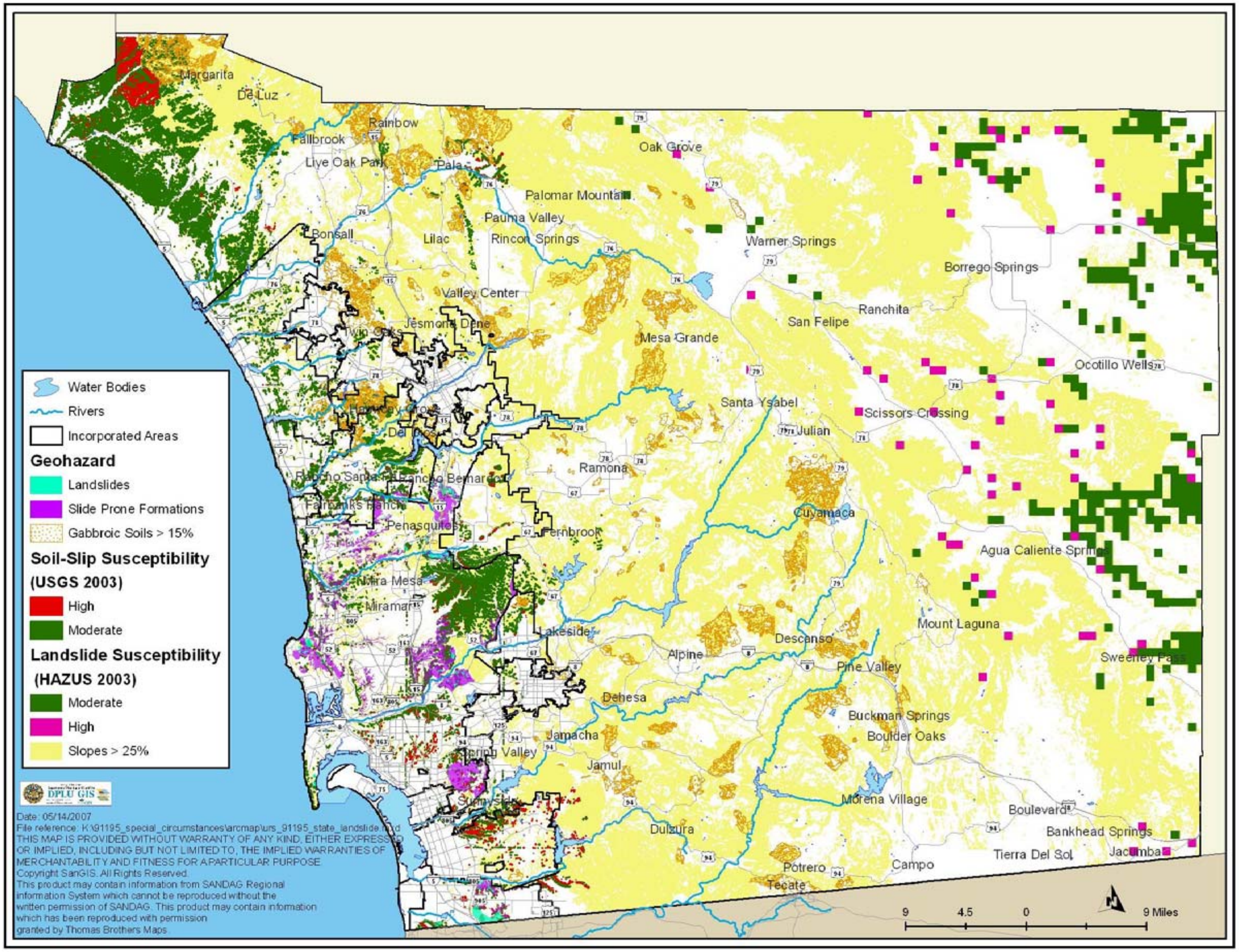
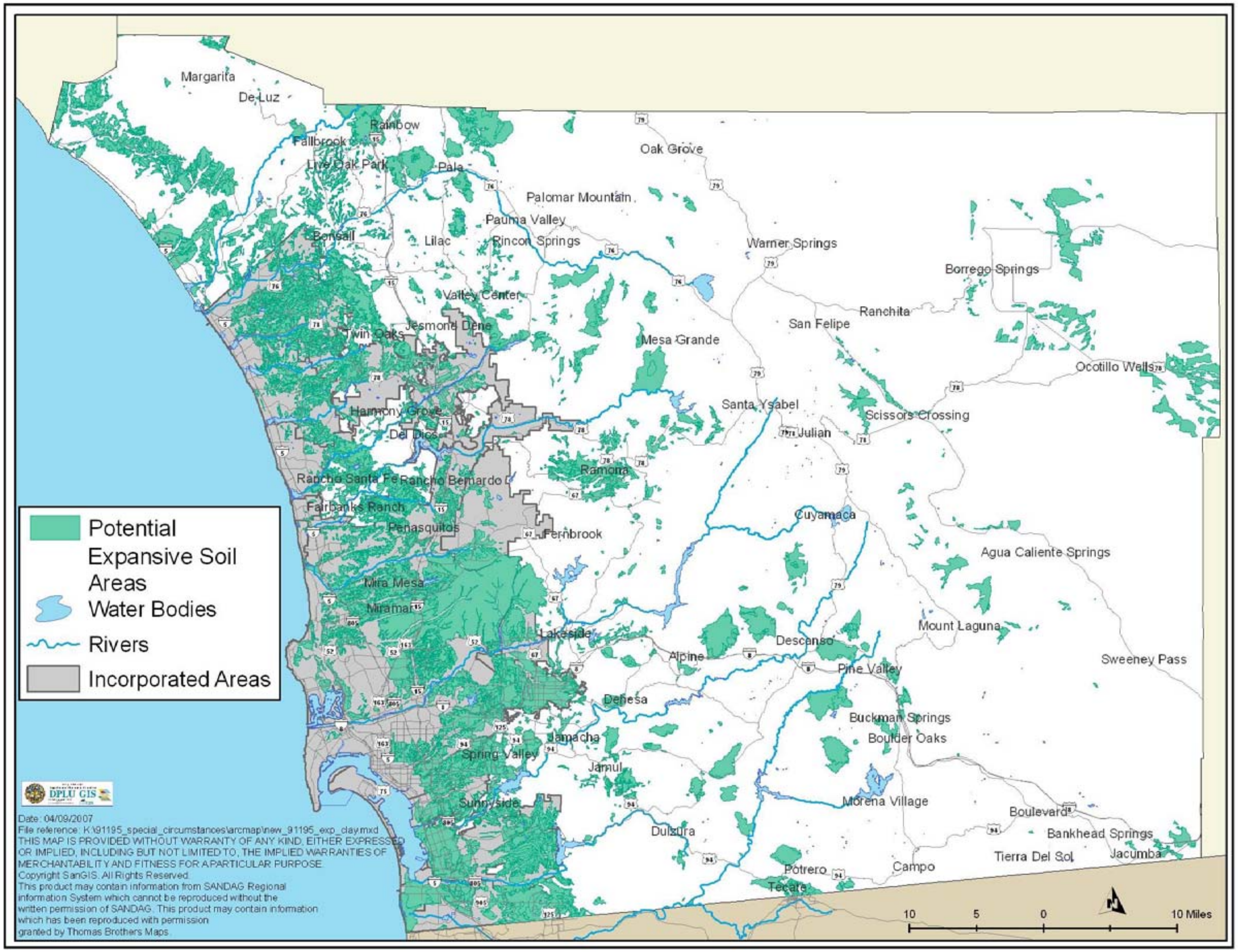


Figure 6 – Potential Expansive Soil Areas



[ATTACHMENT A]

DEFINITIONS

Creep – The slow, steady, downward movement of slope-forming soil or rock.

Crust – The thin, solid, outermost layer of the Earth.

Debris avalanche – A very rapidly moving debris flow.

Debris flow – A landslide made up of a mixture of water-saturated loose soil, rock, organic matter, and air, with a consistency similar to wet cement. Debris flows move rapidly downslope under the influence of gravity. Sometimes referred to as earthflows or mudflows.

Earthflow – See debris flow.

Earthquake – A sudden ground motion or vibration of the Earth, produced by a rapid release of stored-up energy. Includes sudden slip on a fault and the resulting ground shaking and radiated seismic energy caused by the slip.

Fault – A fracture in the Earth along which one side has moved in relative to the other.

Fault Trace – Intersections of faults on the ground surface (horizon); also called fault line

Gabbro – Rock composed of olivine, pyroxene, and plagioclase and having a high clay content. Gabbro is the coarse-grained equivalent of basaltic rocks.

Landslide – The downslope movement of rock, soil, or mud.

Lateral spread – A landslide on a gentle slope, with rapid, fluid-like movement.

Liquefaction – A process by which water-saturated soil temporarily loses strength and acts as a fluid.

Montmorillonite – A very soft mineral of typically microscopic crystals that form a clay. It is the main constituent of the volcanic ash weathering product, bentonite. Montmorillonite's water content is variable and it increases greatly in volume when it absorbs water.

Mudflow – See debris flow.

Plates – Thick, moving slabs of rock composed of crust and the uppermost layer of the under lying mantle.

Richter Magnitude Scale – A measure of an earthquake's size. It describes the total amount of energy released during an earthquake. In the 1930's, C.F. Richter devised a way measure the magnitude of an earthquake using an instrument called a seismograph to measure the speed of ground motion during an earthquake. Geologists discovered that the energy released in an earthquake goes up with magnitude faster than the ground speed by a factor of 32.

Rockfall – Falling, bouncing, or rolling of rocks and/or debris down a steep slope.

Runout – The area where one curved surface merges with another, such as at the bottom of a slope.

Seiche – The sloshing of a closed body of water as a result of an earthquake.

Shear – That type of force that causes or tends to cause two contiguous parts of the same body to slide relative to each other in a direction parallel to their plane of contact.

Seismic – Referring to earthquakes.

Seismogenic – Earthquake producing.

Subduction Zone – Also called a convergent plate boundary. An area where two plates meet and one is pulled beneath the other.

Topple – A landslide where part of a steep slope breaks loose and falls forward.

Tsunami – A large wave or series of waves that are caused by a sudden disturbance that displaces water. The usual cause is an earthquake, submarine landslide, volcanic eruption, or meteor impact.

[ATTACHMENT B]

GUIDELINES FOR THE PREPARATION OF GEOLOGIC REPORTS FOR DISCRETIONARY LAND USE PERMITS

The purpose of these guidelines is to establish format and content requirements of geologic reports required by the County of San Diego Department of Planning and Land Use for projects undergoing CEQA Review. The type of report required depends on the scope of the project and its compatibility with existing geologic conditions. In general, Geologic Investigation or Geologic Reconnaissance Reports may be required for projects located within a potential hazard zone or area. A California Certified Engineering Geologist shall complete the report.

1.0 GEOLOGIC INVESTIGATION

Fault Rupture
Project sites located within an Alquist-Priolo Fault Rupture Zone or a County Special Study Zone may be required to conduct a Geologic Investigation that conforms to the California Geologic Survey's *Guidelines for Evaluating the Hazard of Surface Fault Rupture* and the California Board of Geologists and Geophysicists *Geologic Guidelines for Earthquake and/or Fault Hazard Reports.* The guidelines can be downloaded at the following web addresses:
http://www.consrv.ca.gov/cgs/information/publications/cgs_notes/note_49/note_49.pdf
http://www.geology.ca.gov/publications/earthquake.pdf

The specific requirements to be included in the Geologic Investigation will be determined by the County on a project-by-project basis.

2.0 GEOLOGIC RECONNAISSANCE REPORTS

A Geologic Reconnaissance Report may be required for project sites to address potential geologic hazards concerning risks of fault rupture, liquefaction, and landslides (including rockfall) as discussed below. If multiple hazards exist on or near a project site, a single reconnaissance report would be appropriate to cover all potential geologic hazards present. At the time of the project's initial evaluation, the County may determine that additional information needs to be included in the geologic reconnaissance beyond the minimum requirements discussed below.

Fault Rupture
Project sites located within zones of faults mapped as Quaternary or pre-Quaternary by the DMG may be required to conduct a Geologic Reconnaissance of the project site. The reconnaissance report shall conform to the California Board of Geologists and Geophysicists *Geologic Guidelines for Earthquake and/or Fault Hazard Reports.* The guidelines can be downloaded at the following web address:
http://www.geology.ca.gov/publications/earthquake.pdf

At a minimum, the Geologic Reconnaissance Report should include a review of topographic maps, geologic and soil engineering maps and reports (if available), stereoscopic aerial photographs, and other published and non-published references. A field visit may be necessary to fill in information in questionable areas, and to observe surface features and details that could not be determined from other data sources.

Although engineering design recommendations are generally not a required component of a Geologic Reconnaissance Report, feasible measures to mitigate potential impacts from fault rupture to levels below significance, and environmental design considerations (where appropriate), should also be discussed.

Suspected geologic problems that cannot be evaluated except through in-depth investigation should be clearly described in the report. If the Geologic Reconnaissance Report recommends further investigation, a Geologic Investigation must be prepared. The specific requirements to be included in a Geologic Investigation will be determined by the County on a project-by-project basis.

Liquefaction

Project sites located within a "Potential Liquefaction Area" may be required to conduct a Geologic Reconnaissance Report. As a first screening, the depth to groundwater should be determined for the project site. If the highest groundwater level for the project site is determined to be deeper than 50 feet below the existing ground surface or proposed finished grade (whichever is deeper), no further assessment of potential liquefaction is required.

For projects where the highest groundwater level for the project site is determined to be less than 50 feet, further screening of potential liquefaction is required and the report shall follow guidelines in the California Geologic Survey's *Guidelines for Evaluation and Mitigating Seismic Hazards in California, Special Publication 117, Chapter 6 – Analysis and Mitigation of Liquefaction Hazards.* These guidelines can be downloaded from the California Department of Conservation's Geologic Survey website: http://gmw.consrv.ca.gov/shmp/webdocs/sp117.pdf

Although engineering design recommendations are generally not a required component of a Geologic Reconnaissance Report, feasible measures to mitigate potential impacts from liquifaction to levels below significance, and environmental design considerations (where appropriate), should also be discussed.

Suspected geologic problems that cannot be evaluated except through in-depth investigation should be clearly described in the report. If the Geologic Reconnaissance Report recommends further investigation, a Geologic Investigation must be prepared. The specific requirements to be included in a Geologic Investigation will be determined by the County on a project-by-project basis.

Landslides or Rockfalls

Project sites located on or within 500 feet of a "Landslide Susceptibility Area" may be required to conduct a Geologic Reconnaissance Report. The reconnaissance report shall conform to the California Board of Geologists and Geophysicists *Guidelines for Engineering Geologic Reports.* The guidelines can be downloaded at the following web address:
http://www.geology.ca.gov/publications/engineering.pdf

At a minimum, the Geologic Reconnaissance Report should include a review of topographic maps, geologic and soil engineering maps and reports (if available), stereoscopic aerial photograph review, and other published and non-published references. Aerial photographs can be useful in identifying potential landslide features. Several sets of stereoscopic aerial photographs that pre-date project site area development taken at different times of the year are particularly useful in identifying subtle geomorphic features. A field visit will likely be necessary to fill in information in questionable areas, to address the potential risk of rockfall to the project site, and to observe surface features and details that could not be determined from other data sources.

Although engineering design recommendations are generally not a required component of a Geologic Reconnaissance Report, feasible measures to mitigate potential impacts from landslides or rockfall to levels below significance and environmental design considerations (where appropriate), should also be discussed.

Suspected geologic problems that cannot be evaluated except through in-depth investigation should be clearly described in the report. If the Geologic Reconnaissance Report recommends further investigation, a Geologic Investigation must be prepared. The specific requirements to be included in a Geologic Investigation will be determined by the County on a project-by-project basis.